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AIDS FOR COMPUTING TREE VOLUMES IN ILLINOIS

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IN COOPERATION WITH THE ILLINOIS TECHNICAL FORESTRY ASSOCIATION

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THE ILLINOIS TECHNICAL FORESTRY ASSOCIATION

The Illinois Technical Forestry Association is a society of technical foresters organized for professional, educational, and scientific purposes. Its principal objectives are (1) to plan and to promote full use of the forest land resources of Illinois for the benefit of all the people of the State; (2) to maintain a high level of technical competence and ethical practice among foresters; (3) to foster service for the general welfare; (4) to promote educational meetings and demonstrations independently and in cooperation with conservation agencies; (5) to accept gifts in support of its educational, demonstrational, and research activities; and (6) to use gift funds in advancing scientific knowledge in the field of forestry and land use, and in educating the public as to the importance of proper use and development of the forest land resources of the State.

CONTENTS

	Page
Introduction	1
Objectives	2
Basic tree measurements and computations	2
Cumulative volume tally sheets	4
Cordwood volume tests	4
Rough wood	4
Peeled wood	5
Board-foot volume tests	6
Species tests and correction factors	7
Use of factors	9
Form class	10
Do the form-class tables fit Illinois trees?	10
What factors influence form class?	11
Species form classes and their use	13
Form-class errors	13
Bark thickness	14
Measuring form class	15
Cubic-foot volumes for poles	17
Recommendations and instructions	18
Species list	25
Literature cited	26

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by

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and

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INTRODUCTION

Aids for computing tree volumes for various types of forest inventories have been worked out for Illinois forests. Species correction factors, average form classes, bark ratios for converting the volume of rough wood to a peeled-wood basis, bark thicknesses for ease in determining form classes of standing trees, and cubic volumes for pole-sized trees are presented. These factors and tables should be applicable not only in Illinois but in adjacent states having similar forests. General recommendations and instructions are given for their use.

Particular interest in tree volumes in Illinois has, in recent years, developed through two activities: (1) the local farm forestry districts, and (2) the Illinois Forest Survey. Ten farm forestry districts covering 78 counties, under the cooperative Farm Forestry Act of 1937, have provided farm owners with increased aid in the sound management of their woodlands. Inventories of tree volumes on these woodlands have been made through the use of the cumulative volume tallies (5).[3/] These are single volume tables used for many tree species. They show cumulative volumes for all trees having a given diameter and number of logs, and are very convenient for field use. (See tally forms on pages 20 to 24). Several farm foresters and others who have used the cumulative volume tally sheets, however, have questioned their applicability to Illinois trees. The Forest Survey, on the other hand, was interested in the use of form-class volume tables. Such tables (6) (7) are available for eastern hardwood and southern softwood trees. They are based upon the shape or form of the tree stem and are of particular value where volumes are to be separated by species, types, and sites. The Survey was, therefore, interested in tests to determine how well these tables would fit Illinois trees.

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3/ Underscored numbers in parentheses refer to Literature Cited, page 26.

When the Illinois Survey was started in the fall of 1947, the Central States Forest Experiment Station, its Carbondale Branch, and the Illinois Technical Forestry Association agreed to join forces and study the applicability of the cumulative volume tallies and the form-class volume tables to trees in the state. The Association obtained tree measurements on logging operations throughout the state; the Station measured a number of standing trees with pole calipers, analyzed all of the measurements, and prepared the report.

In addition to farm-woodland inventories and those of extensive forest areas, other classes of forest inventories, such as volumes of individual high-value trees and accurate volume estimates on research sample plots, are occasionally needed. The use of correction factors, form classes, bark ratios and thicknesses, and pole-tree volumes resulting from this study will provide a greater degree of accuracy on all classes of forest inventories.

OBJECTIVES

The objectives of this study were:

(a) to test the cumulative volume tally sheets and compute any necessary correction factors for Illinois trees,

(b) to compute bark ratios for pole-sized trees to permit computation of peeled volumes,

(c) to test the Mesavage-Girard Form Class Tables for board feet (6) and the Mesavage Form Class Tables for cubic feet (7) and to compute average form classes for Illinois trees,

(d) to determine the relationship between bark thickness at breast height and at the top of the first 16-foot log as an aid in determining form class on standing trees, and

(e) to compute average merchantable lengths and average cubic-foot volumes for pole-sized trees.

BASIC TREE MEASUREMENTS AND COMPUTATIONS

The Illinois Technical Forestry Association measured 606 trees which had been cut on logging operations throughout the state. The Station measured 565 standing trees with pole calipers, and the Shawnee National Forest supplied 37 yellow-poplar tree measurements from timber sale operations (fig. 1).

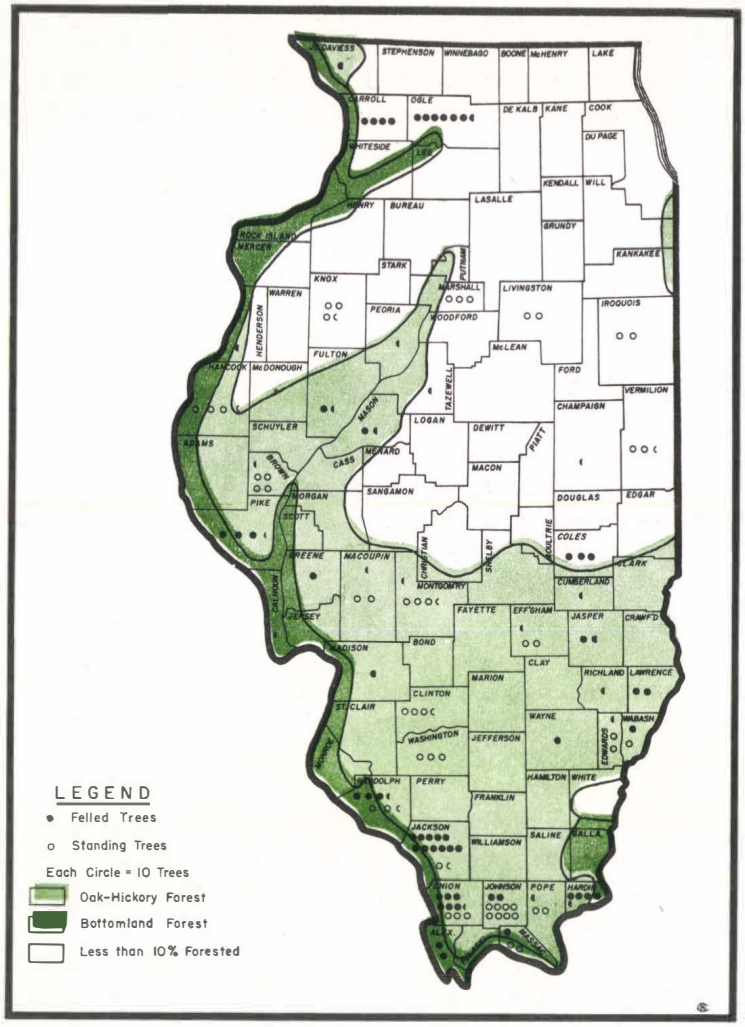

Figure 1.--Location of trees measured in Illinois by counties. Major forest types are shown.

On each felled tree, diameter was measured outside and inside bark at breast height ($4\frac{1}{2}$ feet above ground level) and at each log-cut. These measurements were made with calipers or diameter tapes, and the length of each log was measured. On standing trees, pole calipers were used to measure diameter outside bark at the top of the first 16-foot log on saw-timber trees and at each 8-foot section up to 24 feet on pole-sized trees. The caliper pole was graduated in 1-foot units and was used to measure the length of each section up to 24 feet. Bark thickness at breast height was measured with the Swedish bark instrument. Upper log tapers, merchantable length, and bark thickness were estimated on standing trees.

Cubic volume inside bark was computed by Huber's formula on the 16-foot butt section of each tree. By multiplying the cross-sectional area at the midpoint of the log by the length, this formula eliminates the effect of butt swell. Smalian's formula was used to obtain the cubic volume of all upper logs or sections. It multiplies one-half the sum of the cross-sectional areas at both ends of the log by the length. Board-foot volumes for each 16-foot log were read from the International

1/4-inch, Scribner (formula), and Doyle log-scale tables in Tables For Estimating Board-Foot Volume of Timber, by Mesavage and Girard (6). Volumes of shorter logs were interpolated from tables in Station Note No. 47 (8). Tree volumes were obtained by summing the log volumes for each tree.

Actual computed volumes for these trees were compared with volumes from (a) the cumulative volume sheets and (b) the form-class tables. A description of these tests and their results follow.

CUMULATIVE VOLUME TALLY SHEETS

Preliminary form-class tests of felled trees measured on logging operations and standing trees measured with pole calipers showed significant differences in form between the two groups. These differences resulted from overestimating bark thickness at the top of the first 16-foot log on standing trees. Because of this bias it was necessary to eliminate the standing trees from a number of the tests. For the cumulative tally tests enough felled-tree measurements were available throughout the state to make satisfactory comparisons. The need for bark-thickness factors for use in measuring standing trees with pole calipers will be discussed later.

Four cumulative volume tally sheets were tested. The actual cubic volume of felled pole-sized trees, converted to cords, was compared with the volume of the same trees as estimated by the cordwood cumulative tally (page 23). Only rough wood volumes were used for this comparison, but factors for converting to peeled volume were developed. The scaled board-foot volume of all felled saw-timber trees according to the International 1/4-inch, the Scribner (formula), and the Doyle log rules was compared with each of the three cumulative volume tallies for the same trees (pages 20 to 22). Important differences were found between the scaled and cumulative tally volumes. Further tests showed that these differences were associated with species, and a set of species correction factors was developed for use with the cumulative tally sheets. The results of these tests are discussed below.

CORDWOOD VOLUME TESTS

Rough Wood

The cubic-foot volumes (including bark) of 64 pole-sized trees, 5 to 10 inches d.b.h.,4/ were converted to standard cords (128 cubic feet of stacked wood) by using a factor of 80 cubic feet of solid wood per cord. The cumulative tally volumes in cords were read for each tree from the table on page 24 of The Woodlot Foresters Tool Kit (9).

4/ D.b.h. is diameter breast high or at 4.5 feet above ground level.

Use of the tabular volume rather than the actual cumulative-tally-sheet volume eliminates errors in rounding off that are inherent in the tally sheet when it is used for individual trees. Actual tree volumes were compared with cumulative tally volumes and were found to vary by species. Variations from the cumulative tally ranged from -8.1 percent for pin oak[5] to +11.0 percent for black oak. Cumulative tally volumes of white oak, red oak, hickory, and most bottomland species, however, were within 3 to 4 percent of actual volumes. When the aggregate volume of all trees was compared with the total tally volume, the difference was only 1 percent.

A number of factors are responsible for the wide variations in cordwood volume. Variations by locality in size and straightness of sticks, in utilization limits, and in species, as well as variations in cutting, splitting, and piling practices, tend to make difficult any comparative tests or corrective procedures. In view of these things, as well as the over-all volume difference of only 1 percent shown in the test, we believe that the cordwood cumulative tally can be used safely in Illinois without correction.

Peeled Wood

Accurate determinations of bark volume are important if the volume of peeled wood is desired. For the 64 pole-sized trees used in the above test, volume was computed both inside and outside bark. Bark volume was then determined as a percentage of total volume for each d.b.h. class. No significant difference in the bark percentages were found from one diameter class to another (9 to 14 sample trees of various species were available in each 1-inch class). The average volume of bark for all these trees was found to be 20 percent of the i.b. volume or 16.5 percent of the o.b. volume.[6] Because of differences in thickness and roughness of the bark the bark-volume percentage varied considerably by species. The following volume ratios were obtained using rough wood as the base.

Species	Ratio of volume of peeled wood to rough wood
Hickory	0.78
Post oak	.79
White oak, black walnut, elm, and ash	.80
Black oak	.82
Red oak	.85
Pin oak, shingle oak, river birch, maple, and sycamore	.88
Average all species	0.835

5/ See species list page 25.

6/ I.b. and o.b. refer to inside bark and outside bark respectively.

For most purposes rough-wood volumes in Illinois can be converted to peeled volumes by multiplying by 0.835 or by reducing by 16.5 percent. Where more accurate species volumes are desired, the individual species ratios may be used.

BOARD-FOOT VOLUME TESTS

General tests were made of the International, Scribner, and Doyle board-foot cumulative volume tallies using 529 felled trees of all species. Actual scaled volumes using each rule were compared with volumes from the corresponding cumulative tallies (pp. 20-22). The comparisons showed no very definite relation between volume differences and d.b.h. The 12-inch trees and those above 32 inches, however, had less volume than was shown by the cumulative tallies. The great mass of data between 14 and 30 inches d.b.h. far outweighed these extremes. The average correction percentages for all diameter classes are as follows:

International and Scribner cumulative tallies	+5.2 percent
Doyle cumulative tally	+9.8 percent

SPECIES TESTS AND CORRECTION FACTORS

Because the above general tests showed considerable difference between actual and cumulative tally volumes, a series of species comparisons was made. These comparisons showed that volume differences associated with species were greater than those associated with d.b.h. In most cases volume comparisons by individual species showed that volume differences were not related to d.b.h. Minor differences within species were noted between the northern and southern parts of the state, but these were not considered important for practical woodlot management purposes. Accordingly, one species correction factor can be used for all diameter classes.

Average correction percentages were computed for each species (table 1). Some species require no correction and are estimated properly by the cumulative tally. Others, such as beech and several bottomland species, require a high positive correction of 15 percent for International and Scribner rules, while willow and blackjack oak require a 20 percent reduction. Still others fall between these extremes. The Doyle rule corrections are generally higher than those for the other rules but follow the same trend.

Table 1.--Species correction factors to be applied to cumulative tally volume

Species	Corrections for --	
	International 1/4-inch and Scribner rules	Doyle rule
	Percent	Percent
Bur oak, post oak, maple, and sweetgum	0	0
Ash	+ 3	+ 4
Elm	+ 5	+ 8
Hickory and scarlet oak	+ 6	+ 8
Black oak	+ 7	+12
White oak	+ 8	+13
Red oak	+10	+16
Yellow-poplar	+13	+13
Beech, black tupelo, pin oak, and other bottomland species	+15	+18
Cottonwood	- 3	0
Sycamore	- 7	- 5
Black walnut	-10	-10
Willow and blackjack oak	-20	-20
Weighted average	+ 5.2	+ 9.8

Species correction factors are also given on page 23 of the Woodlot Foresters Tool Kit (9). Comparison of these with the International and Scribner correction factors for Illinois is as follows:

Species	Corrections		Illinois difference
	Illinois	Tool Kit	
	Percent	Percent	Percent
Bur oak	0	0	0
Sugar maple 7/	0	0	0
Elm	+ 5	+ 5	0
Beech	+15	+15	0
Red maple 7/	0	+ 5	- 5
Black walnut	-10	- 3	- 7
Cottonwood	- 3	+ 7	-10
Sycamore	- 7	+ 7	-14
Ash (white, green)	+ 3	0	+ 3
Post oak	0	- 7	+ 7
Hickory	+ 6	- 2	+ 8
White oak	+ 8	- 3	+11
Red oak	+10	- 3	+13

The four species which show no volume difference make up only 13 percent of the sample by number of trees and, according to Forest Survey figures (1), represent about 22 percent of the total cubic volume in the state. The bottomland species with negative differences make up 13 percent of the sample trees and represent about 13 percent of the total volume. These species have considerable bole taper which is due probably to rapid diameter growth. The larger more open-grown trees are usually quite limby. These facts may be the cause of the low relative volume of these bottomland species. The bulk of the sample trees, 62 percent, and the corresponding volume in the state of more than 50 percent, is made up of oak and hickory. These species have volumes which are greater than those given in the cumulative tallies and show positive differences with the species correction factors from the Tool Kit. Differences in average tree form for the two studies probably account for these differences in correction factors. The Illinois trees have relatively high form-class values. Illinois percentage corrections then should be used throughout the state.

It is well to point out here that form-class corrections are recommended for use with the cumulative tallies. Chase (2) in his paper, Cumulative Tallying Brought Up-to-Date, says "The cumulative tally form may be used with satisfaction wherever the average form class for the trees is close to 78. In areas where the form class varies from this average, the volumes from the cumulative tally sheet should be adjusted..." He recommends an increase or decrease of 3 percent in volume for each unit increase or decrease from this average form class. On many field

7/ Sugar, red, and silver maple combined in Illinois.

jobs, however, no form-class measurements are made and no form-class corrections are used. The species corrections above for Illinois include average differences in form class for the state and form class need not be measured when they are used.

Use of Factors

Considerable personal judgment is required in estimating the volume of standing trees in a tract of timber. Knowledge of timber values, local marketing practices, cull, species composition, estimating methods available, and other factors must be considered. These, coupled with the size of the tract and the purpose of the inventory, will pretty much dictate the method of volume determination to be used. For most farm woodland inventories and similar estimates the cumulative volume tally sheets will give satisfactory results if they are properly used and local correction factors are applied. Frequently, more precise estimates are required, such as for high-valued trees or for research, or for detailed inventories of specially managed areas, such as state or federal forests. In these cases the cumulative volume method may not be as satisfactory as some of the other methods now available.

When applying the correction factors presented in the foregoing sections to cumulative volume tally estimates, species composition and values must be considered. If the stand is composed of a mixture and only the total volume is important, the average factors above may be used. This supposes that species with plus factors will tend to offset those having minus factors. In such cases all species can be tallied together. If the species composition of the stand is similar to the state average, the total volume can be multiplied by 1.05 for the International or Scribner rule or by 1.10 for the Doyle rule. Even though good over-all volume estimates can be made using the average correction factor, volume of individual species may have considerable error. These errors may be serious where values by species vary greatly. In this case and in stands where species composition[8/] varies considerably from the average, it may be desirable to correct the volume of each species separately. Species can be tallied separately by using a distinctive species tally mark for each species, by using a separate sheet for each species or species group, or by a combination of both methods. Then, volumes can be summarized by species and can be corrected individually, using the respective species factors given in table 1.

8/ Average species composition of saw timber for the state is given in table 4 of Forest Resources of Illinois (1) as follows:

White oak	20%	Northern red oak	10%	Misc. white oaks	8%	Hickory	7%
Black oak	10%	Elm	10%	Misc. red oaks	7%	Soft maple	6%

The remaining 22 percent is made up of some 20 to 30 other species. If any one species makes up 40 to 50 percent or more of the stand being estimated, it would be desirable to correct for each species.

The estimator must bear in mind that personal errors in measurement and in estimating cull and other elements, may completely nullify any refinements gained by use of correction factors. Personal errors, however, are often compensating and tend to average out, while species errors may be biased and should be corrected. The volume of single trees on the cumulative tally sheet is subject to some error because of rounding off. The more trees accumulated in each block the more accurate the volume estimate. For this reason it may be desirable to tally a number of trees or plots on each sheet.

FORM CLASS

Standard form-class volume tables have been published for both hardwood and softwood timber (6) (7). These tables assume that volume differences of trees of the same diameter and merchantable height are attributed largely to taper variations which occur in the first 16-foot log. Above the first log these trees are assumed to have similar, but not necessarily identical, rates of taper. To use these tables three measurements are needed for each tree: d.b.h., form class, and merchantable height in number of 16-foot logs. Form class is the percentage ratio between diameter inside bark (d.i.b.) at the top of the first 16-foot log and d.b.h. outside bark. D.i.b. at the top of the first log is somewhat difficult to obtain on standing trees, but d.b.h. o.b. is easily measured, and the number of logs and half-logs can, with a little practice, be readily estimated by eye. Of course, accurate measurement of form class can be obtained easily from felled trees, or less easily on standing trees, by the use of climbing irons or ladders.

DO THE FORM CLASS TABLES FIT ILLINOIS TREES?

A general test of the form-class tables was made to see how well they would fit Illinois trees. Measurements from 368 saw-timber trees cut on logging operations throughout the state were used for this test. Actual scaled volumes of the logs cut from these trees were compared with those estimated from the form-class tables, tree by tree. Actual d.b.h., form class, and number of logs for each tree, were used to obtain tabular volumes from the form-class tables. Comparison of actual and tabular volumes show an average percentage difference of only +0.43 percent for board feet, International 1/4-inch rule and +3.5 percent for cubic feet of the same sawlogs. Because form class is independent of log rule, similar tests were not necessary for the Scribner and Doyle rules. These extremely close comparisons, illustrated in figure 2, show that the form-class tables do fit Illinois trees very well when actual form class, d.b.h., and number of logs are known for each tree.

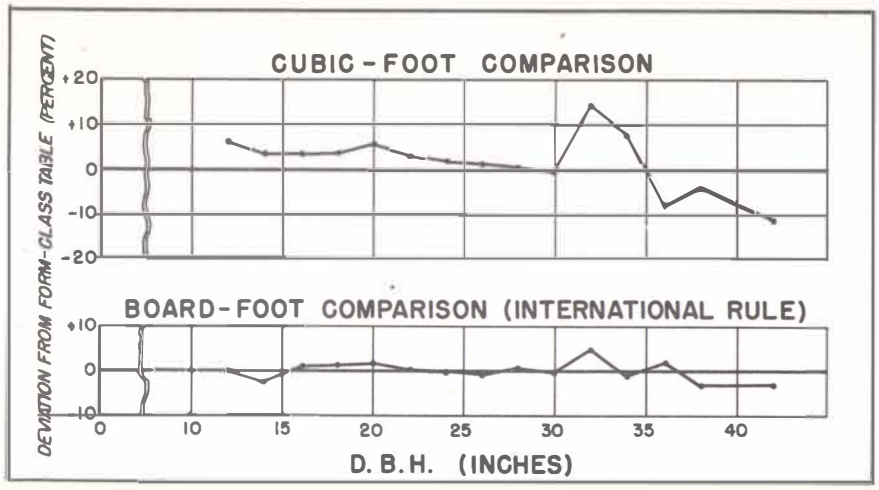

Figure 2.--Comparison of actual tree volumes with form-class table volumes.

WHAT FACTORS INFLUENCE FORM CLASS?

Form class varies considerably from tree to tree. This is due not only to inherent variations in bark thickness and bole shape within and between the different species but also to variations in shape and form due to location. The latter may be due to variations in local site conditions from tree to tree or to competition from neighboring trees. Because of these variations in form class and the difficulty in measuring or estimating form class of individual trees, an analysis was made to find out if any average relation could be found.

Statistical tests, grouping all species together, showed significant correlations of form class with d.b.h. and number of logs but not with bark thickness. Both simple and multiple correlations were rather low, and standard errors of estimate of form class were about the same for all correlations. These were as follows:

Correlations of form class with	Correlation coefficient 9/	Standard error of estimate in form-class units
D.B.H.	.1758**	5.6
Number of logs	.1818**	4.7
Bark thickness	-.0684	--
Number of logs and bark thickness	.1839**	5.6
Number of logs and d.b.h.	.2188**	5.6

9/ A double asterisk following the correlation coefficient indicates it is highly significant (probability beyond the 1 percent level).

Table 2.--Average form class by species group and tree-diameter class

	Species group	Tree-diameter class - inches			
		12	14	16-30	32+
		Form class			
I	Pin oak Shingle oak Honey locust Pecan	77	79	83	75
II	Yellow-poplar White oak	75	82	82	76
III	Red oaks Scarlet oak Elm Beech	79	80	80	80
IV	Black oak Hickory Basswood	73	78	80	80
V	Post oak Bur oak Overcup oak Black tupelo Sweetgum	75	75	78	78
VI	Sycamore Ash Maple Black walnut Butternut Other hardwoods	78	78	77	73
VII	Cottonwood	68	74	79	64
VIII	Baldcypress Willow Hackberry	72	73	75	77
IX	Eastern redcedar	60	60	60	60

When individual species were analyzed separately, practically no significance could be assigned to the relationship between form class and number of logs. After eliminating number of logs as a variable, further analyses of form class were made by both species and diameter. It was found that 12, 14, 16 to 30, and 32 inches and up, were logical diameter groupings. For most species the curves of form class over d.b.h. rise rapidly from 12 to 16 inches and then flatten out. The larger sample trees of many species obtained in this study had short boles and large crowns, were probably open grown, and had excessive taper. For this reason lower form-class values were found for trees larger than 32 inches d.b.h. It was desirable, therefore, to make a separate class for trees 32 inches and above. Some species show relatively high form class at 12 inches and do not increase in form class with increasing diameter. Some species even show a tendency to decrease. All of these things were considered in setting up the species groups.

SPECIES FORM CLASSES AND THEIR USE

Average form classes for Illinois trees are given in table 2 by species and diameter groups. This table groups form class in relatively few diameter classes but gives a fairly detailed species breakdown so that timber volume on smaller areas, with perhaps localized species groupings, can be calculated. Average form classes shown in table 2 can be used with the Mesavage-Girard board-foot tables and the Mesavage cubic-foot tables to determine both board-foot and cubic-foot volumes of saw-timber-sized trees. Trees should be tallied in the woods by species, diameter, and number of logs. Using the species-diameter average form classes from table 2, the volume of any tree can be read from the tables.

FORM-CLASS ERRORS

The standard error of estimate of table 2 is ± 6 form-class units. This indicates that form class of an individual tree can be estimated from the table, two out of three times within ± 6 form-class units. Or, at the customarily accepted 5 percent level--within two standard error units--an individual form class can be estimated 19 out of 20 times within ± 12 form-class units. On the basis of tree volume, this would represent an error of ± 36 percent because a difference of one form-class unit represents about 3 percent difference in volume. Thus the form class of an individual tree can be estimated from table 2 within ± 12 units which is an equivalent of ± 36 percent in volume. When a number of trees are included in the estimate, however, the form class error is much more reasonable (table 3).

Errors of estimate of individual form-class averages in table 2 vary from ± 1.4 to ± 10.8 though most of them are between ± 4 and ± 7. If one species diameter group had an error of ± 12 or twice that for the whole table, the equivalent in percent of volume as shown in the last

column of table 3 would be doubled. The effect of such form-class errors would give volume equivalents within 10 percent on 50 trees or 7 percent on 100 trees. This of course does not include the error inherent in the volume table itself. For most timber-cruising jobs, therefore, the average form classes in table 2 should give reasonable volume accuracies in Illinois when used with the form-class tables.

Table 3.--Standard error of mean form class

Number of trees to be estimated	Standard error of mean form class at		Error at 5 percent level as a percentage of volume
	One standard unit	Two standard units (5 percent level)	
	Form class units	Form class units	Percent
25	1.20	2.40	7.2
50	.85	1.70	5.1
100	.60	1.20	3.6
500	.27	.54	1.6

BARK THICKNESS

It has been shown in figure 2 that the form-class tables for saw-timber-sized trees do fit Illinois trees when actual form class, d.b.h., and number of logs are known for each tree. It has been shown, also, that average form classes can be used by species and diameter groups when the volume of a group of trees is being determined. These average form classes have errors which may be acceptable for use on general or even local surveys. Where higher-precision volume tables are required, or where volumes of individual high-value trees are needed, some method of determining more accurate local form classes is desirable.

As stated previously, the diameter inside bark at the top of the first 16-foot log or at approximately 17 feet above ground level, as well as the d.b.h. o.b., is necessary to determine the form class of a tree. This d.i.b. measurement at 17 feet may be obtained by climbing trees, measuring the outside-bark diameter, and getting the double bark thickness and subtracting, but this is a time-consuming job. When measuring with the pole calipers (3) described by Ferree or the pole diameter tape designed by Godman (4), outside-bark measurements can be obtained with little trouble. Bark thickness at 17 feet is the remaining factor necessary to compute d.i.b. at that point.

At first it was thought that bark thickness at 17 feet could be estimated ocularly using actual bark thickness at breast height as a guide. Careful estimates were made on 565 trees of all species throughout the state. However, comparisons with actual measurements showed that errors of 10 percent or more in mean tree volume resulted. There was a tendency to underestimate bark thickness at 17 feet in trees under 14 to 16 inches d.b.h. and to overestimate larger trees. A study was then made to find a better method of determining bark thickness at 17 feet. It was found that a good relation exists between bark thickness at 17 feet and bark thickness at breast height. Tests showed that species differed both in bark thickness and in the amount of sloughing-off of bark as trees get larger. It was found that the various species could be combined into five groups. For these groups bark thickness at 17 feet was related to that at breast height and averaged by graphing. Average bark thicknesses were then read from these graphs for each species group (table 4).

MEASURING FORM CLASS

When measuring a standing tree to determine form class, d.b.h. can be measured with a diameter tape or calipers. Double bark thickness at breast height should be the sum of bark measurements on two diametrically opposite sides of the tree using a Swedish bark instrument or other means. Measurement of d.o.b. at 17 feet can be made with the pole calipers or pole diameter tape. Referring to the appropriate breast-high double bark thickness in the left column of table 4, the average double bark thickness at the top of the first log can be read for the required species group. This in turn can be subtracted from the reading of the pole calipers or pole tape to get the diameter inside bark at 17 feet. Form class can then be computed for the tree by dividing d.i.b. at 17 feet by d.b.h. outside bark and multiplying by 100.

In connection with research studies the form class and volume of individual trees may be needed before and sometime after treatment. Also, the form class of individual high-valued trees such as veneer trees may be needed to obtain accurate volumes. Where values are not so high but are still important, the average form class for a small woodlot or forest area may be determined by measuring a sample of the standing trees. Here the average form class computed for the sample would determine what form-class volume table should be used. Changes in forest management practices may alter the form class. These changes may necessitate periodic remeasurement of form class on individual trees to assure use of the proper volume tables.

We wish to emphasize here that ocular estimating of form class is likely to result in considerable error. Poor estimates of form class can more than offset the advantages of using form-class tables. For this reason species correction factors as presented in table 1 were computed for use with the cumulative volume tallies without special corrections for form class. Where form class is essential for some detailed jobs as mentioned above, the method just described using table 4 offers a reasonable compromise between ocular estimates and detailed measurements.

Table 4.--Double bark thickness at breast height and at top of first log by species groups

At breast height	Double bark thickness: At top of first 16-foot log (17 feet above ground) by species groups 1/				
	A	B	C	D	E
	Inches				
0.2	0.18	0.20	0.20	0.20	0.15
.4	.29	.40	.40	.40	.32
.6	.41	.60	.60	.60	.50
.8	.52	.74	.80	.80	.67
1.0	.63	.86	1.00	1.05	.85
1.2	.75	.98	1.13	1.30	1.02
1.4	.86	1.10	1.25	1.48	1.20
1.6	.97	1.22	1.36	1.62	1.37
1.8	1.09	1.33	1.48	1.75	1.54
2.0	1.20	1.45	1.60	1.87	1.71
2.2	1.31	1.56	1.72	1.98	1.88
2.4	1.43	1.68	1.84	2.08	2.03
2.6	1.55	1.81	1.96	2.18	2.18
2.8		1.93	2.08	2.26	2.33
3.0		2.05	2.20	2.35	2.46
3.2		2.16	2.32	2.42	2.58
3.4		2.28	2.44	2.50	2.70
3.6		2.40	2.56	2.56	2.81
3.8		2.52	2.68	2.64	2.91
4.0		2.64	2.80	2.70	3.00

1/ Species groups:

A. Sycamore, shingle oak.
B. White, red, post, bur, overcup, scarlet, and blackjack oaks; American beech, maple, boxelder, sweetgum, and honeylocust.
C. Black oak.
D. Cottonwood, ash, yellow-poplar, willow, black walnut, hackberry, and black tupelo.
E. Hickory, pecan, elm.

CUBIC-FOOT VOLUMES FOR POLES

The Mesavage cubic-foot form-class tables for trees of pole size were constructed primarily for eastern hardwoods and southern softwoods. Because they do not fit Illinois trees without considerable adjustment a volume table based on actual pole-tree measurements in Illinois was prepared (table 5). This table gives merchantable lengths and cubic-foot volumes of pole-sized trees in Illinois.

Table 5.--Merchantable length and volume of pole trees by diameter class and species group

D.b.h. (Inches)	Group #1		Group #2		Group #3	
	Merch. length 1/	Volume 2/	Merch. length	Volume	Merch. length	Volume
	Feet	Cu. ft.	Feet	Cu. ft.	Feet	Cu. ft.
6	14	1.5	15	1.7	17	2.0
8	21	3.8	25	4.8	28	5.6
10	26	7.2	32	8.8	37	10.1

1/ Average merchantable length to a 4-inch top inside bark.
2/ Average gross merchantable volume inside bark.

Group #1	Group #2		Group #3
American beech	Ash	Sugar maple	Baldcypress
Post oak	Basswood	Black oak	Black cherry
Bur oak	River birch	White oak	Red maple
	Cottonwood	Pine	Silver maple
	Elm	Black tupelo	Pin oak
	Hackberry	Willow	Red oak
	Hickory	Yellow-poplar	Scarlet oak
	Honeylocust	Others	Shingle oak
			Sassafras
			Sweetgum
			Sycamore
			Black walnut

RECOMMENDATIONS AND INSTRUCTIONS

1. Where rough cordwood volume is desired, i.e. wood and bark, use the cordwood cumulative volume tally without correction. Form 105 R-9 or Form 99 R-9 illustrated on pages 23 and 24 can be used. These forms can be obtained from the Region 9 office of the U. S. Forest Service, Milwaukee, Wisconsin. Rough cordwood volumes for Illinois trees can be converted to peeled volumes by multiplying by the ratios shown on page 5.

2. On over-all timber estimates of saw-timber-sized trees--i.e. where species, types, sites, and other subclasses are not separated, and where an average distribution of species is expected (see footnote 8 page 9)--use the cumulative tally sheet for the desired log rule and apply the average correction factor of +5.2 percent for International and Scribner rules and +9.8 percent for Doyle. This method can be used for either large or small areas.

3. For timber estimates where one or two species predominate or where species value varies, use either the cumulative tally with species corrections from table 1, or use average form classes from table 2 and read volumes from the Mesavage-Girard board-foot and the Mesavage cubic-foot form-class tables for sawlog volumes. This method can be used, also, for either large or small forest areas.

When using the cumulative tally sheet keep the different species or species groups separate. This can be done by special species marks or by using separate tally sheets. Correct the board-foot volume of each species or group by adding or subtracting the volume correction indicated in table 1.

When determining volumes by means of the average form class, tally trees by species, d.b.h., and number of logs. Using the proper form classes from table 2, read volumes for each tree-size class from the form-class volume tables and multiply by the number of trees in the class. Volumes can then be summarized as desired.

4. On rather detailed surveys where species, types, and sites are to be separated, use average form classes from table 2 and the Mesavage-Girard board-foot and Mesavage cubic-foot form-class tables as indicated under item 3 above. This method is commonly used on fairly large areas of several thousand acres.

5. Where detailed surveys are made of high-valued timber in rather restricted areas, measure actual form class (as explained on page 15) on a number of trees of each principal species or species group and compute average form classes for the species or for important diameter classes within the species or species group. Using these average form classes, read volumes from the form-class tables.

When actual form-class averages are determined the cumulative tally sheets could be used and the volumes corrected as described by Chase (2) as mentioned on page 8. There may be some advantage in the use of this method when it is desirable to determine volume immediately on the ground.

6. Where extreme value occurs such as for veneer trees or on research studies where accuracy is desired, measure the actual form class of each tree (see page 15) and read volumes from the form-class volume tables.

7. For cubic-foot volumes of pole-sized trees use volumes shown in table 5.

FORM 102 R-9

INTERNATIONAL CUMULATIVE VOLUME TALLY SHEET

Based on Composite Volume Tables by the

Lake States Forest Experiment Station - 1943

NAME _____ INTERNATIONAL

COUNTY _____ DATE _____

STATE _____ ESTIMATOR _____

SECTION _____ TWP. _____ RANGE _____ FORTY. _____

VOLUME IN HUNDREDS OF BOARD FEET - INTERNATIONAL

DBH	NUMBER OF 16 FOOT LOGS																VARIABLE TOP TO 8" D.I.B.									TOTAL B.F. PER A.
	½			1					1½				2				2½			3			3½	4		
12	2	3	4	3	6	9	11	14	4	8	12	16	5	10	15	6	LEGEND & CULL %									PLOTS TALLIED
	6	8	9	17	20	23	26	28	20	24	28	32	20	25	30	12										
	10	12	14	31	34	37	40	43	36	40	44	48	35	40	45	17										CULL TREES
	15	16	18	46	48	51	54	57	52	56	60	64	50	55	60	23										
	20	21	22	60	63	66	68	71	68	72	76	80	65	70	75	29										
14	2	4	6	4	8	12	16	20	6	11	16	22	7	14	21	8										AV.DBH
	8	10	13	24	28	32	36	40	28	33	38	44	28	35	42	16										
	15	17	19	43	47	51	55	59	50	55	60	66	49	56	63	24	33	41	3							NEAR MERCHANTABLE TREES
	21	23	25	63	67	71	75	79	72	77	82	88	70	77	84	49	57	65	9	18						
	27	29	32	83	87	91	95	99	94	99	104	110	91	98	105	73	82	90	27	36						
	34	36	38	103	107	111	115	118	116	121	126	132	112	119	126	98	106	114	45	54						
16	3	6	9	5	10	16	21	26	7	15	22	29	9	18	27	11	21	32	12	25	37	3½	4			
	12	15	18	32	37	42	47	52	37	44	51	59	36	45	54	43	53	64	49	62	74	14	15			
	21	24	27	68	63	68	74	79	66	74	61	88	63	72	81	75	85	96	86	99	111	28	31			
	30	32	35	84	89	94	100	105	96	103	110	118	90	99	108	106	117	128	124	136	148	42	46			
	38	41	44	110	116	121	126	131	125	132	140	147	117	126	135	138	149	160	161	173	185	56	62			
18	4	7	11	7	14	20	27	34	9	19	28	38	12	24	36	14	26	42	16	32	48	18	20			
	15	16	22	40	47	54	61	68	47	56	66	75	47	59	70	56	70	83	64	80	96	36	40			
	26	30	33	74	81	88	94	101	85	94	103	113	82	94	106	97	111	125	112	128	144	54	60			
	37	41	44	108	115	122	128	135	122	132	141	150	118	129	141	139	153	167	160	176	192	72	80			
20	5	9	14	8	17	26	34	42	12	24	35	47	15	30	44	18	35	52	20	40	60	22	25			
	18	23	28	51	60	68	76	85	59	71	83	94	59	74	88	70	88	105	80	100	121	45	50			
	32	37	41	94	102	110	119	128	106	118	130	142	103	118	133	122	140	158	141	161	181	68	75			
	46	51	55	136	144	153	162	170	153	165	177	189	148	162	177	175	192	210	201	221	241	90	100			
22	6	11	17	10	21	31	42	52	14	29	44	58	18	36	54	22	43	64	25	49	74	28	31			
	22	28	34	63	73	84	94	104	72	87	102	116	72	90	109	86	108	129	99	124	146	56	61			
24	7	13	20	13	25	38	50	63	17	35	52	69	22	43	65	26	51	77	30	59	69	33	37			
	27	33	40	76	88	101	113	126	86	104	121	138	86	108	129	102	128	154	119	148	178	66	74			
26	8	16	24	15	30	45	60	75	20	41	61	82	25	51	76	30	60	91	36	70	105	39	44			
	32	40	47	90	105	120	135	150	102	123	143	164	102	127	152	121	151	181	140	174	209	79	88			
28	9	19	28	17	35	52	70	87	24	48	72	96	30	60	90	35	70	106	41	81	122	46	51			
	37	47	66	104	122	139	157	174	120	143	167	191	119	149	179	141	176	212	162	203	244	92	102			
30	11	22	33	20	41	61	82	102	28	55	83	110	34	69	103	41	81	122	47	93	140	53	59			
32	13	26	38	24	47	71	94	118	32	64	96	129	40	79	119	47	94	140	54	108	162	61	68			
34	15	29	44	27	53	80	107	134	36	73	110	146	45	90	135	53	106	159	61	122	183	69	77			
36	16	33	50	30	60	90	120	150	41	82	123	164	51	101	152	60	120	179	69	138	206	78	87			
38	19	37	56	34	67	101	135	168	46	91	137	183	56	113	170	67	134	200	77	154	231	87	97			
40	21	42	62	37	74	112	149	186	50	101	151	201	62	125	187	74	146	221	85	170	255	96	108			
42	23	46	69	41	82	123	163	204	55	110	165	220	68	136	204	80	161	242	93	187	280	106	118			

(A) MULTIPLY the SUM of last figures used in each block by 100.****(1) For VOLUME PER ACRE divide this product by the NUMBER of 1/5 acre plots.--(2) For MARKING TALLY VOLUME divide the product (from A) by 5.

FORM 103 R-9

SCRIBNER CUMULATIVE VOLUME TALLY SHEET

Based on Composite Volume Tables by the

Lake States Forest Experiment Station - 1943

NAME _____ SCRIBNER

COUNTY _____ DATE _____

STATE _____ ESTIMATOR _____

SECTION _____ TWP. _____ RANGE _____ FORTY. _____

VOLUME IN HUNDREDS OF BOARD FEET - SCRIBNER

DBH	NUMBER OF 16 FOOT LOGS																VARIABLE TOP TO 6" D.I.B.									TOTAL B.F. PER A.
	½			1					1½				2				2½		3		3½		4			
12	1	3	4	2	5	7	10	12	3	7	10	13	4	8	12	5	LEGEND & CULL %				PLOTS TALLIED					
	6	7	8	14	17	19	22	24	16	20	23	26	16	20	23	10										
	10	11	13	26	29	31	34	36	30	33	36	40	27	31	35	15										
	14	15	17	38	41	43	46	48	43	46	50	53	39	43	47	19					CULL TREES					
	16	20	21	50	53	55	58	60	56	59	63	66	51	55	58	24										
14	2	4	6	4	7	10	14	16	5	10	14	19	6	12	17	7					AV. DBH ____					
	8	10	12	21	24	28	32	35	24	29	34	38	23	29	35	14										
	14	16	18	36	42	46	49	52	43	46	53	56	41	46	52	21	28	35	3		NEAR MERCHANTABLE TREES					
	20	22	24	56	60	63	66	70	62	67	72	77	56	64	70	42	49	56	8	16						
	26	28	30	74	77	80	84	88	82	86	91	96	75	81	87	63	70	78	25	33						
	32	34	36	91	94	98	102	105	101	106	110	115	93	99	104	85	92	99	41	50						
16	3	5	8	5	9	14	19	23	6	13	19	26	8	16	24	10	19	29	11	22	34	3½	4			
	11	14	16	26	33	37	42	46	32	39	45	52	32	40	47	36	48	57	45	56	67	13	14			
	19	22	24	51	56	60	65	70	56	64	71	77	55	63	71	67	78	88	76	90	101	26	28			
	27	30	32	74	79	84	88	93	84	90	97	103	79	87	95	98	105	115	112	123	134	38	42			
	35	38	40	98	102	107	112	116	110	116	123	129	103	111	118	124	134	145	146	157	168	50	56			
18	4	7	11	6	12	18	24	30	8	17	26	34	10	21	31	12	25	37	15	29	44	16	16			
	14	16	22	37	43	49	55	61	42	50	59	67	41	52	62	50	62	74	58	73	88	32	36			
	25	29	32	67	73	79	85	92	76	84	92	101	72	83	93	87	99	112	102	117	131	46	53			
	36	40	43	98	104	110	116	122	108	118	126	134	104	114	124	124	136	149	146	161	175	65	71			
20	4	9	14	8	16	23	31	39	11	21	32	42	13	26	39	16	32	48	18	37	55	20	23			
	16	22	27	47	55	62	70	78	53	64	74	85	52	66	79	63	79	95	73	92	110	41	45			
	32	36	40	86	94	101	109	117	95	106	117	127	92	105	118	111	127	143	128	146	165	61	68			
	45	50	54	125	133	140	148	156	138	148	159	170	131	144	157	158	174	190	183	201	220	81	90			
22	6	11	17	10	19	29	39	48	13	26	39	52	16	33	49	20	39	59	23	45	66	25	28			
	22	28	33	58	66	78	87	97	68	79	92	105	66	82	98	78	98	118	90	113	136	50	56			
24	7	14	21	12	24	35	47	59	16	32	48	64	20	40	60	24	47	71	27	55	82	31	34			
	27	34	41	71	83	94	106	118	80	96	112	128	80	100	120	94	118	142	110	137	165	61	69			
26	8	16	25	14	28	42	56	70	19	38	57	76	24	48	72	28	57	85	33	65	98	36	41			
	33	41	50	84	98	112	126	140	95	114	133	152	96	120	143	113	142	170	131	163	196	73	82			
28	10	20	29	17	33	50	66	83	22	45	67	90	28	56	84	33	68	100	38	78	116	43	48			
	39	49	58	99	116	132	149	166	112	134	157	179	112	140	168	133	166	200	153	191	229	86	96			
30	11	23	34	19	36	57	77	96	26	52	78	104	32	65	97	39	77	116	44	89	133	50	56			
32	13	26	39	22	44	66	88	110	30	60	90	120	37	75	112	44	89	133	51	102	153	57	64			
34	15	29	44	26	50	75	100	126	34	68	102	136	42	85	127	50	101	151	58	116	174	65	73			
36	16	33	50	28	56	85	113	141	38	77	115	153	48	96	143	57	114	170	65	131	196	73	82			
38	18	38	55	32	63	95	127	158	43	86	128	171	53	107	160	63	127	190	73	146	219	82	92			
40	20	40	60	35	70	105	141	176	48	95	143	190	59	118	177	70	141	211	82	163	245	91	103			
42	22	44	66	39	78	117	155	194	52	105	157	210	65	130	195	78	155	232	90	180	270	101	113			

(A) MULTIPLY the SUM of last figures used in each block by 100.0000(1) For VOLUME PER ACRE divide this product by the NUMBER of 1/5 acre plots.--(2) For MARKING TALLY VOLUME divide the product (from A) by 5.

FORM 104 R-9

DOYLE CUMULATIVE VOLUME TALLY SHEET

Based on Composite Volume Tables by the

Lake States Forest Experiment Station - 1945

NAME _____ DOYLE

COUNTY _____ DATE _____

STATE _____ ESTIMATOR _____

SECTION _____ TWP _____ RANGE _____ FORTY _____

VOLUME IN HUNDREDS OF BOARD FEET - DOYLE

DBH	NUMBER OF 16 FOOT LOGS																VARIABLE TOP TO 8" D.I.B.								TOTAL B.F. PER A.	
	½			1					1½				2				2½			3			3½	4		
12	1	2	3	1	3	4	6	7	2	4	6	8	2	5	7	3	LEGEND & CULL %								PLOTS TALLIED	
	4	4	5	9	10	12	13	14	10	11	13	15	9	12	14	5										
	6	7	8	16	17	19	20	22	17	19	21	23	16	18	21	8										
	9	10	11	23	25	26	28	29	25	27	28	30	23	25	28	10									CULL TREES	
	12	13	14	30	32	33	35	36	32	34	36	38	30	32	34	13										
14	1	3	4	2	5	7	10	12	3	7	10	13	4	8	12	4									AV.DBH ___	
	6	7	8	15	17	20	22	24	16	20	23	26	16	20	24	9										
	10	11	13	27	29	32	34	37	30	33	36	40	28	32	36	14	18	22	3						NEAR MERCH-ANTABLE TREES	
	14	15	17	39	42	44	47	49	43	46	50	53	40	43	47	27	32	36	5	10						
	18	20	21	51	54	58	59	61	56	59	63	66	51	55	59	40	45	50	16	21						
	22	24	25	64	66	69	71	74	69	73	76	79	63	67	71	54	58	63	26	31						
16	2	4	6	4	7	11	14	18	5	10	15	20	6	12	18	7	14	21	8	16	24	3½	4			
	8	10	13	21	25	28	32	36	24	29	34	39	24	30	36	28	36	43	32	40	49	9	9			
	15	17	19	39	43	46	50	53	44	49	54	59	42	48	54	50	57	64	57	65	73	18	19			
	21	23	25	57	60	64	67	71	64	69	74	78	60	67	73	71	78	85	81	89	97	26	28			
	27	29	32	75	78	82	85	89	83	88	93	98	79	85	91	92	99	106	105	113	122	35	38			
18	3	6	9	5	10	15	20	25	7	13	20	27	8	16	25	10	20	29	11	22	34	12	13			
	12	15	18	30	35	40	45	50	34	40	47	54	33	41	50	39	49	59	45	56	67	25	27			
	21	24	27	54	59	64	69	74	60	67	74	80	68	66	74	69	78	88	78	90	101	37	40			
	30	33	36	79	84	89	94	99	87	94	100	107	82	91	99	98	108	118	112	123	134	50	54			
20	4	8	12	6	13	20	26	32	9	18	27	35	11	22	33	13	26	39	15	30	45	16	18			
	16	20	24	39	46	52	58	65	44	53	62	71	44	55	66	52	65	78	59	74	89	33	36			
	28	32	36	72	78	84	91	98	80	88	97	106	77	88	99	91	104	117	104	119	134	50	54			
	40	44	48	104	110	117	124	130	115	124	133	142	110	121	132	130	143	156	148	163	178	66	72			
22	5	10	15	8	17	26	34	42	12	23	34	46	14	28	43	17	34	50	19	38	57	21	23			
	20	25	30	51	60	68	76	85	58	69	80	92	57	71	85	67	84	101	77	96	115	43	46			
24	6	13	19	11	22	32	43	54	15	29	44	58	18	36	54	21	43	64	24	49	73	27	30			
	26	32	39	64	75	86	97	108	73	88	102	117	72	90	108	86	107	128	97	122	146	54	60			
26	8	16	24	13	26	40	53	66	18	36	53	71	22	44	65	26	52	78	30	59	89	33	37			
	32	40	48	80	93	106	119	132	89	106	124	142	87	109	131	104	130	155	119	148	178	67	74			
28	10	19	29	16	32	48	64	80	21	43	64	86	26	52	78	31	62	93	35	71	106	40	44			
	38	48	58	96	112	128	144	160	107	128	150	171	104	130	156	124	155	186	142	177	212	80	89			
30	11	23	34	19	38	57	75	94	25	51	76	101	31	63	94	37	74	111	42	84	126	47	52			
32	13	27	40	22	44	66	88	110	30	59	89	118	37	73	110	43	86	129	49	99	148	56	61			
34	15	30	46	25	51	76	102	127	34	68	102	136	42	85	127	50	100	150	57	114	171	65	72			
36	17	35	52	29	58	87	116	145	39	78	117	156	48	97	146	57	114	171	65	131	196	74	82			
38	19	39	58	33	66	99	132	165	44	88	132	176	55	110	165	65	129	194	74	148	223	84	93			
40	22	43	64	37	74	111	149	186	50	99	148	198	62	123	184	72	145	218	83	166	250	94	104			
42	24	47	71	41	83	124	166	207	55	110	165	220	68	137	205	81	162	243	93	186	279	105	116			

(A) MULTIPLY the SUM of last figures used in each block by 100.•••• (1) For VOLUME PER ACRE divide this product by the NUMBER of 1/5 acre plots.--(2) For MARKING TALLY VOLUME divide the product (from A) by 5.

FORM 105 R-9

CORDWOOD CUMULATIVE VOLUME TALLY SHEET

NAME _____ CORDWOOD

COUNTY _____ DATE _____

STATE _____ ESTIMATOR _____

SECTION _____ TWP. _____ RANGE _____ FORTY _____

UNPEELED VOLUME IN TENTHS OF CORDS (REDUCE 12% FOR PEELED VOLUME)

DBH	NUMBER OF 8 FOOT BOLTS PER TREE																VARIABLE TOP TO 4" D.I.B.						TOTAL CORDS PER ACRE
	1			2						3				4			PLOTS TALLIED						
6	1	2	3	2	3	4	6	8	9	2	4	6	9	3	6	9							
	4	4	5	10	12	14	15	16	18	11	13	15	17	12	14	17							
	6	7	8	20	21	22	24	25	27	19	22	24	26	20	23	26							
	9	10	11	28	30	32	33	34	36	28	30	32	34	29	32	35	LEGEND & CULL %						
	12	13	14	38	39	40	42	44	45	37	39	41	43	38	41	44							
	14	15	16	46	48	50	51	52	54	45	47	49	52	46	49	52							
	17	18	19	56	57	58	60	62	63	54	56	58	60	55	58	61							
	20	21	22	64	66	68	69	70	72	62	64	67	69	64	67	70							
	22	23	24	74	75	76	78	80	81	71	73	75	77	72	75	78	5						
8	2	3	5	2	5	8	10	12	16	3	7	10	14	5	9	14	8	12	17				
	5	6	10	18	20	22	25	28	30	18	21	24	28	18	23	28	22	29	35	AREA UNMERCHANTABLE TREES			
	11	13	14	32	35	38	40	42	45	32	35	38	42	32	37	41	41	46	52				
	16	18	19	48	50	52	55	58	60	46	49	52	56	46	51	55	58	64	70				
	21	22	24	62	65	66	70	72	75	60	63	66	70	60	64	69	75	81	87				
	26	27	29	78	80	82	85	88	90	74	77	80	84	74	76	83	93	99	104				
	30	32	34	92	95	99	100	102	105	88	91	94	98	87	92	97	110	116	122				
	35	37	38	106	110	111	115	116	120	102	105	108	112	101	106	110	128	135	139	6			
	40	42	43	122	125	128	130	132	135	116	119	122	128	115	120	124	145	151	157				
10	2	5	7	4	7	11	15	18	22	5	10	15	20	7	13	20	8	17	25	10	20		
	10	12	15	26	29	33	36	40	44	25	30	35	40	26	33	40	33	42	50	30	40		
	17	20	22	47	51	55	58	62	66	45	50	56	61	46	53	59	58	67	75	50	60		
	24	27	29	69	73	77	80	84	88	66	71	76	81	66	73	79	84	92	100	70	80		
	32	34	37	91	95	99	102	106	110	86	91	96	101	86	92	99	109	117	125	90	100		
	39	42	44	113	117	120	124	128	131	106	111	116	121	106	112	119	134	142	150	110	120		
	47	48	51	135	139	142	146	150	153	126	131	136	141	125	132	139	159	167	175	130	140	7	
	54	56	59	157	161	164	168	172	175	146	152	157	162	145	152	158	184	192	200	150	160		
12	5	7	10	5	10	15	20	25	30	7	14	21	28	9	18	27	11	22	34	14	27	18	33
	16	18	21	35	40	45	50	55	60	34	41	48	55	36	45	54	45	56	68	41	54	49	65
	24	26	32	65	70	75	80	85	90	62	69	76	83	63	72	81	79	90	101	68	81	81	97
	36	38	42	95	100	106	110	115	120	90	97	104	110	90	99	108	112	124	135	95	108	116	130
	46	49	52	125	130	134	140	145	150	117	124	131	138	117	126	136	146	158	169	122	136	146	162
14	5	10	14	7	13	20	27	34	40	9	18	27	36	12	23	35	15	29	44	18	35	21	42
	19	24	28	47	54	60	67	74	80	45	54	63	72	47	58	70	58	73	87	53	70	68	84
	33	38	43	87	94	101	107	114	121	81	90	98	107	82	98	106	102	118	131	88	106	105	126
16	6	12	18	6	17	25	33	42	50	11	22	33	44	14	29	44	18	36	54	22	44	26	52
	24	30	35	56	67	75	84	92	100	56	67	78	89	58	72	87	72	90	108	66	87	76	104
18	8	15	22	10	20	31	41	51	62	14	27	40	54	16	35	52	22	44	65	27	53	32	68
20	9	18	28	12	25	37	49	62	74	16	32	48	64	21	42	62	26	52	78	32	63	38	76
22	11	22	33	15	29	44	58	73	88	19	35	56	75	24	49	74	31	61	92	37	74	44	88

(A) MULTIPLY the SUM of last figures used in each block by 0.1 cccc(1) For VOLUME PER ACRE divide this product by the NUMBER of 1/5 acreoplots.--(2) For MARKING TALLY VOLUME divide the product (from A) by 5.

FORM 99 R-9
REV 6-17 47

CUMULATIVE 1/5 ACRE TALLY SHEET

DBH
2"
4"

ESTIMATOR _____ DATE _____
COURSE _____ PLOT _____ SEC _____ T. _____ R _____

MAP TYPE
PLOT TYPE

DBH | SPEC & LEGEND | NON-MERCH.

NUMBER OF 8-FOOT BOLTS (4" OR LARGER) PER TREE

1 | 2 | 3 | 4

MORTALITY / ACRE

NO. TREES: 2 | 4
VOL BY SPECIES: SPEC. | CDS. | BD. FT.

TOTALS PER ACRE

VOLUME IN TENTHS OF CORDS PER ACRE

6

1 2 3 4 5 6 6 7 8 9 / 1 3 4 6 7 9 10 12 13 15 16 / 2 4 6 9 11 13 15 17 19 22 / 3 6 9 12 14 17
10 11 12 13 14 15 16 / 18 19 21 22 24 25 27 28 / 24 26 28 30 32 35 37 39 41 / 20 23 26 29 32
17 18 18 19 20 21 / 30 31 33 34 36 37 39 40 / 43 45 48 50 52 54 56 58 60 / 35 37 40 43 46 49
22 23 24 25 26 27 / 42 43 45 46 48 49 51 52 / 63 65 67 69 71 73 76 78 80 / 52 55 58 60 63 66

1 2 3 4 5 6 6 7 8 / 1 3 4 6 7 9 10 12 13 15 / 2 4 6 9 11 13 15 17 19 22 / 3 6 9 12 14 17 20
9 10 11 12 13 14 / 16 18 19 21 22 24 25 27 / 24 26 28 30 32 35 37 39 41 / 23 26 29 32 35 37 40
15 16 17 18 18 19 / 28 30 31 33 34 36 37 39 / 43 45 48 50 52 54 56 58 60 / 43 46 49 52 55 58 60

1 2 3 4 5 6 6 6 7 / 1 3 4 6 7 9 10 12 13 15 / 2 4 6 9 11 13 15 17 19 / 3 6 9 12 14 17 20 23
8 9 10 11 12 13 / 16 18 19 21 22 24 25 27 / 22 24 26 28 30 32 35 37 / 26 29 32 35 37 40 43 46

1 2 3 4 5 6 6 / 1 3 4 6 7 9 10 12 13 15 / 2 4 6 9 11 13 15 17 19 / 3 6 9 12 14 17 20 23 26
7 8 9 10 11 12 13 / 16 18 19 21 22 24 25 27 / 22 24 26 28 30 32 35 37 / 29 32 35 37 40 43 46 49

5 | 6

8

2 3 5 6 8 10 11 / 2 5 7 10 12 15 17 20 22 / 3 7 10 14 17 21 24 28 / 5 9 14 18 23 28 32 37 41 / 6 12 17 / 7 14
13 14 16 18 / 25 27 30 32 35 37 40 / 31 35 38 42 45 49 52 56 / 46 51 55 60 65 69 74 78 / 23 29 35 / 21 28
19 21 22 24 / 42 45 47 50 52 55 57 / 60 63 66 70 73 77 80 84 / 83 88 92 97 101 106 111 / 41 46 52 58 / 34 41 48
26 27 29 30 / 60 62 64 67 69 72 74 / 87 91 94 98 101 105 108 / 115 120 124 129 134 138 / 64 70 75 81 / 55 62 69

AVERAGE PERCENT DEFECT

POLES

2 3 5 6 8 10 / 2 5 7 10 12 15 17 20 / 3 7 10 14 17 21 24 28 / 5 9 14 18 23 28 32 37 41 / 6 12 17 23 / 7 14 21
11 13 14 16 / 22 25 27 30 32 35 37 / 31 35 38 42 45 49 52 56 / 46 51 55 60 65 69 74 78 / 29 35 41 46 / 28 34 41
18 19 21 22 / 40 42 45 47 50 52 55 / 60 63 66 70 73 77 80 84 / 83 88 92 97 101 106 111 / 52 58 64 70 / 48 55 62

2 3 5 6 8 / 2 5 7 10 12 15 17 20 / 3 7 10 14 17 21 24 28 / 5 9 14 18 23 28 32 37 / 6 12 17 23 29 / 7 14 21 28
10 11 13 / 22 25 27 30 32 35 37 / 31 35 38 42 45 49 52 56 / 41 46 51 55 60 65 69 74 / 35 41 46 52 58 / 34 41 48 55

2 3 5 6 8 / 2 5 7 10 12 15 17 20 / 3 7 10 14 17 21 24 28 / 5 9 14 18 23 28 32 37 / 6 12 17 23 29 / 7 14 21 28
10 11 13 / 22 25 27 30 32 35 37 / 31 35 38 42 45 49 52 56 / 41 46 51 55 60 65 69 74 / 35 41 46 52 58 / 34 41 48 55

7

10

2 5 7 10 / 4 7 11 15 18 22 26 / 5 10 15 20 25 30 35 41 / 7 13 20 26 33 40 46 53 / 8 17 25 33 42 / 10 20 30 40 50 / 12 24 36 48
12 15 17 / 29 33 37 40 44 48 / 46 51 56 61 66 71 76 / 59 66 73 79 86 92 99 106 / 50 58 67 75 83 / 60 70 80 90 100 / 60 72 84 96
20 22 25 / 51 55 59 62 66 70 / 81 86 91 96 101 106 / 112 119 126 132 139 145 / 92 100 109 117 / 110 120 130 140 / 108 120 132

2 5 7 / 4 7 11 15 18 22 26 / 5 10 15 20 25 30 35 / 7 13 20 26 33 40 46 53 / 8 17 25 33 42 / 10 20 30 40 50 / 12 24 36 48
10 12 15 / 29 33 37 40 44 48 / 41 46 51 56 61 66 71 / 59 66 73 79 86 92 99 106 / 50 58 67 75 83 / 60 70 80 90 100 / 60 72 84 96

2 5 7 / 4 7 11 15 18 22 26 / 5 10 15 20 25 30 35 / 7 13 20 26 33 40 46 53 / 8 17 25 33 42 50 / 10 20 30 40 50 60 / 12 24 36 48
10 12 / 29 33 37 40 44 48 / 41 46 51 56 61 66 71 / 59 66 73 79 86 92 99 106 / 58 67 75 83 92 100 / 70 80 90 100 110 / 60 72 84 96

2 5 7 / 4 7 11 15 18 22 / 5 10 15 20 25 30 35 / 7 13 20 26 33 40 46 53 / 8 17 25 33 42 50 / 10 20 30 40 50 60 / 12 24 36 48

TOT. CORDS

NUMBER OF 16-FOOT LOGS (8" OR LARGER) PER TREE

1/2 | 1 | 1 1/2 | 2

RECOMMENDED CUT (NET) / ACRE

TYPE OF CUT | PERIOD | SPEC. | CORD | M BD. FT.

IMPROVEMENT

SALVAGE

ROTATION

2 1/2

TOTAL

TOTAL NET VOLUME
SPECIES | CORDS | M. BD. FT.

VOLUME IN HUNDREDS OF BOARD FEET (SCRIBNER) PER ACRE

10

1 1 2 3 3 4 5 / 2 3 4 6 7 9 10 12 13 / 2 4 6 8 10 12 14 16
6 6 7 8 8 9 10 / 15 16 18 19 21 22 24 / 18 20 22 24 26 28 30
11 11 12 13 13 / 25 27 28 30 31 33 34 / 32 34 36 38 40 42 44
14 15 15 16 17 / 36 37 39 40 42 43 45 / 46 48 50 52 54 56 58

1 1 2 3 3 4 5 / 2 3 4 6 7 9 10 12 13 / 2 4 6 8 10 12 14 16
6 6 7 8 8 9 10 / 15 16 18 19 21 22 24 / 18 20 22 24 26 28 30
11 11 12 13 13 / 25 27 28 30 31 33 34 / 32 34 36 38 40 42 44

1 1 2 3 3 4 5 / 2 3 4 6 7 9 10 12 / 2 4 6 8 10 12 14 16
6 6 7 8 8 9 / 13 15 16 18 19 21 22 / 18 20 22 24 26 28 30

1 1 2 3 3 4 5 / 2 3 4 6 7 9 10 12 / 2 4 6 8 10 12 14 16

12

1 3 4 6 7 8 / 2 5 7 10 12 14 17 19 / 3 7 10 13 16 20 23 / 4 8 12 16 20 23 / 5 10 15 19
10 11 13 14 / 22 24 29 29 31 34 / 26 30 33 36 40 43 / 27 31 35 39 43 47 / 24 29 34 39
15 17 18 20 / 38 41 43 46 48 50 53 / 50 53 56 59 63 66 69 / 51 55 58 62 66 70 / 44 48 53 58
21 22 24 25 / 55 58 60 62 65 67 70 / 73 76 79 82 86 89 92 / 74 78 82 86 90 94 / 63 68 73 78

1 3 4 6 7 8 / 2 5 7 10 12 14 17 19 / 3 7 10 13 16 20 23 / 4 8 12 16 20 23 / 5 10 15 19
10 11 13 14 / 22 24 29 29 31 34 / 26 30 33 36 40 43 / 27 31 35 39 43 47 / 24 29 34 39
15 17 18 20 / 36 38 41 43 46 48 / 46 50 53 56 59 63 / 51 55 58 62 66 70 / 44 48 53 58

1 3 4 6 7 8 / 2 5 7 10 12 14 17 19 / 3 7 10 13 16 20 23 / 4 8 12 16 20 23 / 5 10 15 19
10 11 13 14 / 22 24 29 29 31 34 / 26 30 33 36 40 43 / 27 31 35 39 43 47 / 24 29 34 39

1 3 4 6 7 8 / 2 5 7 10 12 14 17 19 / 3 7 10 13 16 20 23 / 4 8 12 16 20 23 / 5 10 15 19 24 / 3 / 3 1/2

14

2 4 6 8 10 12 / 4 7 10 14 18 21 24 / 5 10 14 19 24 29 34 / 6 12 17 23 29 35 / 7 14 21 28 / 8 16 25 33 / 9 19
14 16 18 20 / 28 32 35 38 42 46 / 38 43 48 53 58 62 / 41 46 52 58 64 70 / 35 42 49 56 / 41 50 58 / 28 38
22 24 26 28 / 49 52 56 60 63 66 / 67 72 77 82 86 91 / 75 81 87 93 99 / 63 70 78 85 / 66 74 82 / 47 57

AVERAGE PERCENT DEFECT

SAWTIMBER

2 4 6 8 10 12 / 4 7 10 14 18 21 24 / 5 10 14 19 24 29 34 / 6 12 17 23 29 35 / 7 14 21 28 / 8 16 25 33 / 9 19
14 16 18 20 / 28 32 35 38 42 46 / 38 43 48 53 58 62 / 41 46 52 58 64 70 / 35 42 49 56 / 41 50 58 66 / 28 38

2 4 6 8 10 / 4 7 10 14 18 21 24 / 5 10 14 19 24 29 34 / 6 12 17 23 29 35 / 7 14 21 28 / 8 16 25 33 / 9 19
12 14 16 18 / 28 32 35 38 42 46 / 38 43 48 53 58 62 / 41 46 52 58 64 70 / 35 42 49 56 / 41 50 58 66 / 28 38

2 4 6 8 10 / 4 7 10 14 18 21 24 / 5 10 14 19 24 29 34 / 6 12 17 23 29 35 / 7 14 21 28 / 8 16 25 33 / 9 19 / 4 / 4 1/2 / 5

16

3 5 8 11 14 / 5 9 14 19 23 28 / 6 13 19 26 32 39 / 8 15 24 32 40 47 / 10 19 29 38 / 11 22 34 45 / 13 25 / 14 28
16 19 22 24 / 33 37 42 46 51 56 / 45 52 58 64 71 77 / 55 63 71 79 87 95 / 48 57 67 76 / 56 67 78 90 / 38 50 / 42 56

3 5 8 11 14 / 5 9 14 19 23 28 / 6 13 19 26 32 39 / 8 15 24 32 40 47 / 10 19 29 38 / 11 22 34 45 / 13 25 / 14 28
16 19 22 24 / 33 37 42 46 51 56 / 45 52 58 64 71 77 / 55 63 71 79 87 95 / 48 57 67 76 / 56 67 78 90 / 38 50 / 42 56

3 5 8 11 14 / 5 9 14 19 23 28 / 6 13 19 26 32 39 / 8 15 24 32 40 47 / 10 19 29 38 / 11 22 34 45 / 13 25 / 14 28

3 5 8 11 14 / 5 9 14 19 23 28 / 6 13 19 26 32 39 / 8 15 24 32 40 47 / 10 19 29 38 / 11 22 34 45 / 13 25 / 14 28

18

4 7 11 14 / 6 12 18 24 30 37 / 8 17 25 34 42 50 / 10 21 31 41 52 62 / 12 25 37 50 / 15 29 44 58 / 16 32 / 18 36
18 22 25 / 43 49 55 61 69 / 59 67 76 84 92 / 72 83 93 104 114 / 62 74 87 99 / 73 88 102 / 48 65 / 53 71

4 7 11 14 / 6 12 18 24 30 37 / 8 17 25 34 42 50 / 10 21 31 41 52 62 / 12 25 37 50 / 15 29 44 58 / 16 32 / 18 36

4 7 11 14 / 6 12 18 24 30 37 / 8 17 25 34 42 50 / 10 21 31 41 52 62 / 12 25 37 50 / 15 29 44 58 / 16 32 / 18 36

4 7 11 14 / 6 12 18 24 30 37 / 8 17 25 34 42 50 / 10 21 31 41 52 62 / 12 25 37 50 / 15 29 44 58 / 16 32 / 18 36

20

4 9 14 18 / 8 16 23 31 39 47 / 11 21 32 42 53 64 / 13 26 39 52 66 79 / 16 32 48 63 79 / 18 37 55 73 / 20 41 / 23 45 / 25 50
22 27 32 / 55 62 70 78 86 / 74 85 95 106 117 / 92 105 118 131 144 / 95 111 127 143 / 92 110 128 / 61 81 / 68 90 / 75 100 / 27

4 9 14 18 / 8 16 23 31 39 47 / 11 21 32 42 53 64 / 13 26 39 52 66 79 / 16 32 48 63 79 / 18 37 55 73 / 20 41 / 23 45 / 25 50 / 27

4 9 14 18 / 8 16 23 31 39 47 / 11 21 32 42 53 64 / 13 26 39 52 66 79 / 16 32 48 63 79 / 18 37 55 73 / 20 41 / 23 45 / 25 50 / 27

22

6 11 17 22 / 10 19 29 39 48 / 13 26 39 52 66 / 16 33 49 66 82 98 / 20 39 59 78 / 23 45 68 90 / 25 50 / 28 56 / 31 62 / 33

6 11 17 22 / 10 19 29 39 48 / 13 26 39 52 66 / 16 33 49 66 82 98 / 20 39 59 78 / 23 45 68 90 / 25 50 / 28 56 / 31 62 / 33

6 11 17 22 / 10 19 29 39 48 / 13 26 39 52 66 / 16 33 49 66 82 98 / 20 39 59 78 / 23 45 68 90 / 25 50 / 28 56 / 31 62 / 33

24

7 14 21 / 12 24 35 47 59 / 16 32 48 64 80 / 20 40 60 80 100 / 24 47 71 94 / 27 55 82 110 / 31 61 / 34 69 / 38 75 / 41

7 14 21 / 12 24 35 47 59 / 16 32 48 64 80 / 20 40 60 80 100 / 24 47 71 94 / 27 55 82 110 / 31 61 / 34 69 / 38 75 / 41

7 14 21 / 12 24 35 47 59 / 16 32 48 64 80 / 20 40 60 80 100 / 24 47 71 94 / 24 55 82 110 / 31 61 / 34 69 / 38 75 / 41

26

8 16 25 / 14 28 42 56 70 / 19 38 57 76 95 / 24 48 72 96 120 143 / 28 57 85 113 / 33 65 98 131 / 36 73 / 41 82 / 45 90 / 49

8 16 25 / 14 28 42 56 70 / 19 38 57 76 95 / 24 48 72 96 120 143 / 28 57 85 113 / 33 65 98 131 / 36 73 / 41 82 / 45 90 / 49

28

10 20 29 / 17 33 50 66 / 22 45 67 90 112 / 28 55 84 112 140 168 / 33 66 100 133 / 38 76 115 153 / 43 86 / 48 96 / 53 / 57

10 20 29 / 17 33 50 66 / 22 45 67 90 112 / 28 55 84 112 140 168 / 33 66 100 133 / 38 76 115 153 / 43 86 / 48 96 / 53 / 57

30

11 23 34 / 19 38 57 77 / 26 52 78 104 / 32 65 97 130 162 / 39 77 116 154 / 44 89 133 177 / 50 100 / 56 111 / 61 / 67

11 23 34 / 19 38 57 77 / 26 52 78 104 / 32 65 97 130 162 / 39 77 116 154 / 44 89 133 177 / 50 100 / 56 111 / 61 / 67

32

13 26 39 / 22 44 66 88 / 30 60 90 120 / 37 75 112 149 186 / 44 89 133 178 / 51 102 153 204 / 57 114 / 64 128 / 71 / 78

13 26 39 / 22 44 66 88 / 30 60 90 120 / 37 75 112 149 186 / 44 89 133 178 / 51 102 153 204 / 57 114 / 64 128 / 71 / 78

34

15 29 / 25 50 75 100 / 34 68 102 136 / 42 85 127 169 212 254 / 50 101 151 202 / 58 116 174 232 / 65 129 / 73 146 / 81 / 89

36

16 33 / 28 56 85 113 / 38 77 115 153 / 48 96 143 191 239 / 57 114 170 227 / 65 131 196 261 / 73 146 / 82 164 / 92 / 101

38

18 36 / 32 63 95 127 / 43 86 128 171 / 53 107 160 214 267 / 63 127 190 254 / 73 146 219 293 / 82 164 / 92 184 / 103 / 115

40

20 40 / 35 70 105 / 48 95 143 190 / 59 118 177 237 296 / 70 141 211 281 / 82 163 245 326 / 91 182 / 103 205 / 116 / 129

42

22 44 / 39 78 117 155 / 53 106 158 211 / 65 130 196 261 326 / 78 155 232 310 / 90 180 270 360 / 101 202 / 113 225 / 129 / 145

SPECIES LIST

Ash, white (Fraxinus americana L.), pumpkin (F. tomentosa Michx.f.)
green (F. pennsylvanica Marsh.) blue (F. quadrangulata Michx.)

Baldcypress (Taxodium distichum [L.] Rich.)
Basswood, american (Tilia americana L.)
Beech, american (Fagus grandifolia Ehrh.)
Birch, river (Betula nigra L.)

Cherry, black (Prunus serotina Ehrh.)
Cottonwood, eastern (Populus deltoides Bartr.) swamp (P. heterophylla L.)

Elm, american (Ulmus americana L.), slippery (U. rubra Muhl.), rock
(U. thomasi Sarg.)

Hackberry, (Celtis occidentalis L.)
Hickory, bitternut (Carya cordiformis [Wangenh.] K. Koch), mockernut
(C. tomentosa Nutt.), shellbark (C. laciniosa [Michx.f.] Loud.),
shagbark (C. ovata [Mill.] K. Koch), pignut (C. glabra [Mill.] Sweet)
Pecan (Carya illinoensis [Wangenh.] K. Koch)
Honeylocust (Gleditsia triacanthos L.)

Maple, sugar (Acer saccharum, Marsh.), red (A. rubrum L.), silver
(A. saccharinum L.)
Boxelder (Acer negundo L.)

Oak, black (Quercus velutina Lam.)
Oak, blackjack (Q. marilandica Muenchh.)
Oak, bur (Q. macrocarpa Michx.)
Oak, overcup (Q. lyrata Walt.)
Oak, pin (Q. palustris Muenchh.), cherrybark (Q. falcata var. leucophylla
ashe)
Oak, post (Q. stellata Wangenh.)
Oak, northern red (Q. borealis Michx.f.) southern red (Q. falcata Michx.)
Oak, scarlet (Q. coccinea Muenchh.)
Oak, shingle (Q. imbricaria Michx.)
Oak, white (Q. alba L.)

Pine, shortleaf (Pinus echinata Mill.) white (P. Strobus L.)

Sassafras (Sassafras albidum [Nutt.] Ness)
Sweetgum (Liquidambar styraciflua L.)
Sycamore, american (Platanus occidentalis L.)

Tupelo, black (Nyssa sylvatica Marsh.) (Synonym, blackgum)

Walnut, black (Juglans nigra L.), butternut (J. cinerea L.)
Willow, black (Salix nigra Marsh.)

Yellow-poplar (Liriodendron tulipifera L.)

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(4) Godman, R. M.
1949. The Pole Diameter Tape. Jour. Forestry 47:568-569.

(5) Macon, John W., and Gevorkiantz, S. R.
1942. Estimating Volume on the Spot. Jour. Forestry 40:652.

(6) Mesavage, Clement, and Girard, James W.
1946. Tables for Estimating Board-foot Volume of Timber. U. S. Dept. Agr., Forest Service.

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1947. Tables for Estimating Cubic-foot Volume of Timber. Southern Forest Experiment Station, New Orleans, La. Occasional Paper 111, 70 pp. (Multilithed).

(8) Schnur, G. Luther, and Lane, Richard D.
1948. Log Rule Comparison, International 1/4-inch, Doyle, and Scribner. Central States Forest Experiment Station, Columbus 15, Ohio. Station Note No. 47, (Multilithed).

(9) U. S. Dept. Agr., Forest Service - Region 9, Milwaukee 3, Wisconsin.
1946. The Woodlot Foresters Tool Kit.

Species Correction Factors

To be applied to cumulative tally volume for Illinois trees

Species	Corrections for-- Int. ¼-inch & Scribner rules	Doyle rule
	Percent	Percent
Bur & post oak, maple & sweetgum	0	0
Ash	+ 3	+ 4
Elm	+ 5	+ 8
Hickory & scarlet oak	+ 6	+ 8
Black oak	+ 7	+12
White oak	+ 8	+13
Red oak	+10	+16
Yellow-poplar	+13	+13
Beech, black tupelo, pin oak & other bottomland species	+15	+18
Cottonwood	- 3	0
Sycamore	- 7	- 5
Black walnut	-10	-10
Willow & blackjack oak	-20	-20
Weighted average	+5.2	+9.8

U. S. Dept. Agr., Forest Service, Central States Forest Experiment Station, 111 Old Federal Building, Columbus 15, Ohio

(Cut and insert in field notebook)

Average Form Classes-Illinois Trees

	Species group	Tree diameter class 12"	14"	16-30"	32"+
1.	Pin & shingle oak, pecan, honeylocust	77	79	83	75
2.	White oak, yellow-poplar	75	82	82	76
3.	Red & scarlet oak, elm, beech	79	80	80	80
4.	Black oak, hickory, basswood	73	78	80	80
5.	Post, bur & overcup oaks, black tupelo, sweetgum	75	75	78	78
6.	Ash, black walnut, butternut, sycamore and other hardwoods	78	78	77	73
7.	Cottonwood	68	74	79	64
8.	Baldcypress, hackberry, willow	72	73	75	77
9.	Eastern redcedar	60	60	60	60

Average number of logs per tree

10"	1 log
12"	1½ logs
14 - 24"	2 logs
26 - 28"	2½ logs
30"+	3 logs

U. S. Dept. Agr., Forest Service, Central States Forest Experiment Station, 111 Old Federal Building, Columbus 15, Ohio

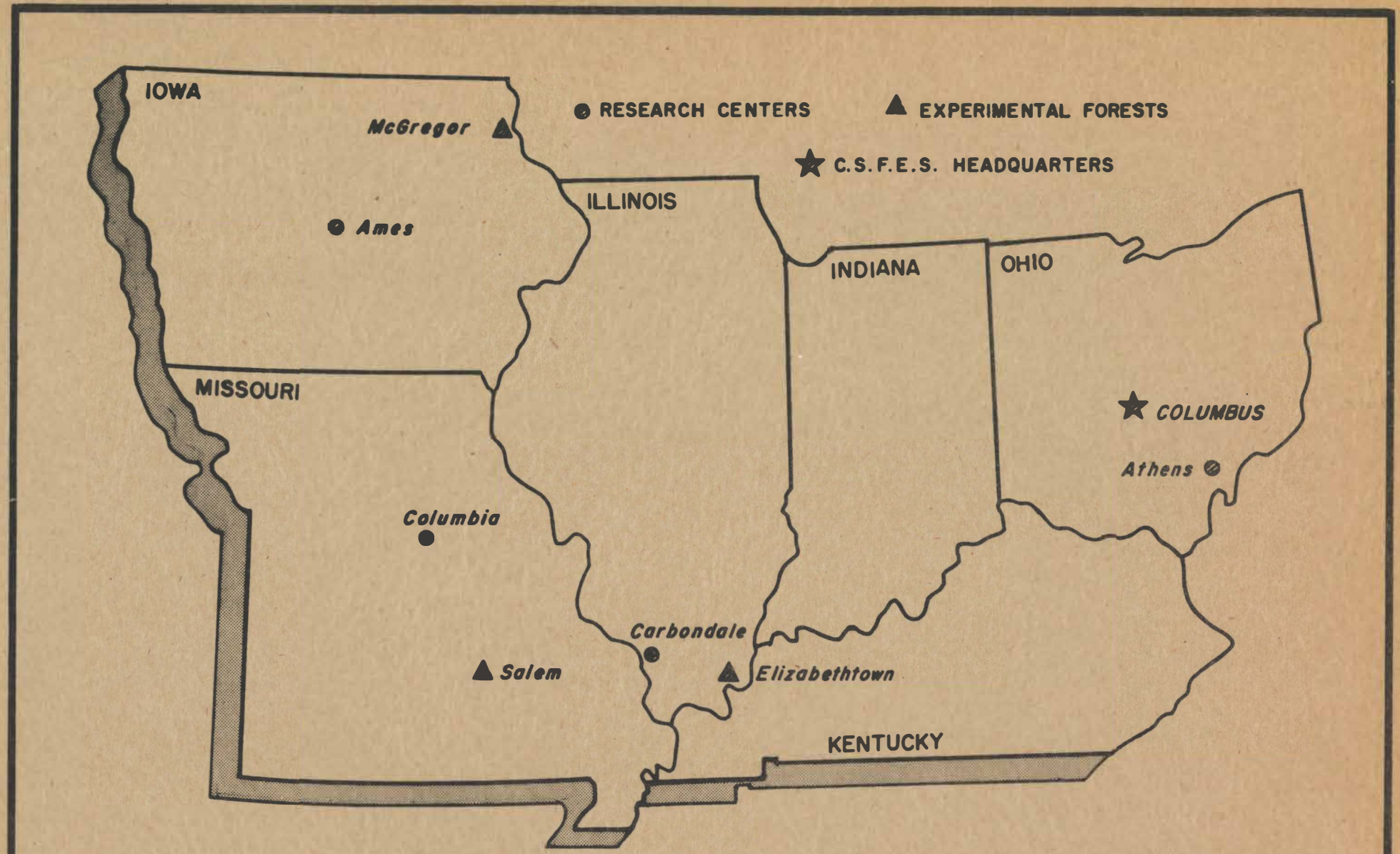
Double bark thickness for Illinois trees

At B.H.:	Double bark thickness-inches At top of first 16-foot log by species groups 1/ A	B	C	D	E
0.2	.18	.20	.20	.20	.15
.4	.29	.40	.40	.40	.32
.6	.41	.60	.60	.60	.50
.8	.52	.74	.80	.80	.67
1.0	.63	.86	1.00	1.05	.85
1.2	.75	.98	1.13	1.30	1.02
1.4	.86	1.10	1.25	1.48	1.20
1.6	.97	1.22	1.36	1.62	1.37
1.8	1.09	1.33	1.48	1.75	1.54
2.0	1.20	1.45	1.60	1.87	1.71
2.2	1.31	1.56	1.72	1.98	1.88
2.4	1.43	1.68	1.84	2.08	2.03
2.6	1.55	1.81	1.96	2.18	2.18
2.8		1.93	2.08	2.26	2.33
3.0		2.05	2.20	2.35	2.46
3.2		2.16	2.32	2.42	2.58
3.4		2.28	2.44	2.50	2.70
3.6		2.40	2.56	2.56	2.81
3.8		2.52	2.68	2.64	2.91
4.0		2.64	2.80	2.70	3.00

1/ Species groups

A. Sycamore, shingle oak
B. White, red, post, bur, overcup, scarlet & blackjack oaks, American beech, maple, boxelder, sweetgum & honeylocust.
C. Black oak
D. Ash, cottonwood, black tupelo, black walnut, hackberry, willow & yellow-poplar
E. Elm, hickory, & pecan

U. S. Dept. Agr., Forest Service, Central States Forest Experiment Station, 111 Old Federal Building, Columbus 15, Ohio



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